REMARKS

Non-elected claims 23-39 have been canceled.

Claims 2 and 15-22 have been rejected under 35 USC §112, second paragraph, as being indefinite. In response to these rejections the term "or the like" has been removed from claim 2. In addition, the term "room temperature" has been deleted from the claims, and replaced with a temperature range "of about 20°C to 30°C".

Claims 1-10 and 12-22 have been rejected under 35 USC 103(a) over Nguyen (US Patent No. 5,150,195) in view of Park et al (US Patent No. 5,834,836), Cain (US Patent No. 5,656,945) and Mariotti et al (US Patent No. 4,490,515). Claim 11 has been rejected under 35 USC §103(a) over Nguyen, Park et al., Cain, Mariotti et al. and further in view of Hiraoka et al. (U.S. Patent No. 5,589,554).

In response to the 35 USC §103 rejections the claims have been amended. In addition, the Examiner is asked to consider the arguments to follow.

<u>Amended Claims</u>

The amended claims are directed to a method for attaching a semiconductor die to a leadframe. The method includes the step of "providing a cyanoacrylate adhesive material formulated to cure in less than about 60 seconds at a temperature of about 20°C to 30°C and at an ambient atmosphere". The adhesive material is initially applied to the die 10 (Figure 1A) or to the leadframe 14 (Figure 1A). For leadframes 14 having a mounting paddle 12 (Figure 1B) the adhesive material can be applied to the mounting paddle 12. For lead-on-chip leadframes 14A (Figure 5), the adhesive material can be applied to leadfingers 38 (Figure 5), configured to support the die 10A (Figure 5).

Following the adhesive "applying" step, a "placing" step is performed wherein the die is placed "on the leadframe with the adhesive material in contact with the die, and the

leadframe to form an adhesive layer therebetween". The adhesive layer 20 (Figure 1B) is then subjected to a "curing" step "at the temperature and at the ambient atmosphere in less than 60 seconds to bond the die to the leadframe".

For performing the "curing" step the leadframe can be provided with "condensed ambient humidity" (page 10, lines 6-10 of the specification). Alternately, a "catalyst", such as water or an acid, can be applied to the leadframe, to the die, or to the adhesive material (page 9, lines 4-8 of the specification).

With the claimed method, since the curing step is performed at 20°C to 30°C, neither the die, or the leadframe, is heated during the curing step. This is a departure from conventional die attachment processes in which heat is used to perform the curing step. In addition, curing steps for conventional die attachment processes typically take several minutes to perform. In contrast the presently claimed curing process takes less than 60 seconds.

Amended independent claim 1 recites the above outlined method. Amended independent claim 6 includes essentially the same recitations as claim 1, and also includes the recitation of "providing the leadframe and the die with condensed ambient humidity". In addition, independent claim 6 states that the "curing" step includes "interaction" of the "adhesive material" with the "humidity".

Amended independent claim 12 includes essentially the same recitations as claim 1, and also states that the leadframe includes "leadfingers", such as the leadfingers of a lead-on-chip leadframe.

Amended independent claim 15 includes essentially the same recitations as claim 1, and also recites the step of "applying a catalyst to the leadframe or to the die". Independent claim 15 also states that the curing step is performed by "interaction" of the "adhesive material" with the catalyst.

The method of the invention can also be performed with an "anaerobic acrylic adhesive" rather than a "cyanoacrylate adhesive" (page 9, lines 9-16 of the specification). Amended independent claim 21 includes essentially the same recitations as claim 1, but with an "anaerobic acrylic adhesive". Added independent claim 42 includes essentially the same recitations as claim 21, and also recites the step of "applying a catalyst to the leadframe or to the die" and that the adhesive material cures by "interaction" with the "catalyst".

Rejections Under 35 USC §103

The amended claims are submitted to include recitations that patentably distinguish the claimed method from the prior art. A first unobvious feature of the method is that the die attach process is performed at the stated temperature range of 20°C to 30°C such that neither the die, or the leadframe is heated. This provides a process advantage in that a low thermal budget is maintained for the die.

The Nguyen reference was cited as teaching the importance of a "rapid curing rate" (column 1, lines 42-45). However, Nguyen also teaches the conventional technique of heating the die to a temperature of 200°C for two minutes (column 3, line 28). The curing process is thus shortened, but the die can be adversely affected by the heat. In addition, by teaching a heat curing process Nguyen in effect "teaches away" from the presently claimed low temperature process.

References that teach away from the claimed invention support unobviousness, rather than obviousness. See for example W.L. Gore & Associates, Inc. v. Garlock, Inc., 721 F.2d 1540, 220 USPQ 303 (Fed Cir. 1983) and Raytheon Co. v. Roper Corp., 724 F.2d 951, 220 USPQ 592 (Fed. Cir. 1983).

Another unobvious feature of the invention is performing the die attach process using either a "cyanoacrylate adhesive" or "an anaerobic acrylic adhesive". No references

were cited in which die attach to a leadframe is performed using a cyanoacrylate adhesive or an anaerobic acrylic adhesive.

The Office Action states that "Use of cyanoacrylates to bond dies to lead frames is well-known and conventional in the art as evidenced by Park and Cain". This assertion is respectfully disputed.

With respect to Cain, this reference discloses an "apparatus for testing a nonpackaged die". As shown in Figures 3-5, the apparatus includes "a mounting assembly 116 for temporarily and nonpermanently mounting die 22 within socket 102" (column 7, lines 54-56). The mounting assembly 116 includes a button 117 (Figure 4) that is attached to a dimple 132 on a base 127 of the assembly using a "cyanoacrylate polymer or anaerobic cement 133" (column 8, lines 9-12). However, this cement 133 does not attach a die to a leadframe, as presently claimed. Rather, as stated at column 8, lines 22-26 of Cain: "Die 22 is mounted on platform 126" using "A suitable adhesive such as a thin tacky layer 143 of any suitable liquid or polymer such as silicone, wafer or vacuum oil".

With respect to Park et al., an "anisotropic conductor 5" (Figure 4) is stated to possibly include a "cyanoacrylate" (column 4, line 44). However, the anisotropic conductor 5 attaches chips 1, 2, to an "insulating circuit film 3" (column 3, line 26), rather than directly to a leadframe as presently claimed. The anisotropic conductor 5 of Park et al. includes conductive particles (column 4, lines 47-49) that provide a conductive path between contacts on the chips 1, 2 and the insulating circuit film 3. As shown in Figure 6, the lead frame of Park et al. includes leads 4. As shown in Figure 4, the leads 4 attach to the insulating film 3, rather than to a leadframe mounting paddle, or to LOC lead fingers of a leadframe, as presently claimed.

Admittedly, Park et al. states at column 4, line 46 that hardening of the anisotropic conductor 5 can occur at room

temperature. However, no time frame is mentioned, and no particular adhesive formulation is specified. In addition, Park et al. also teaches conventional heat curing of the anisotropic conductor 5, at column 5, lines 25-27. Accordingly a low temperature die attach process using an adhesive layer formed between the die and the leadframe is not suggested by Park et al.

Another unobvious feature of the present method is the use of a "catalyst" on the die or the leadframe to speed the curing process. The Hiraoka reference was cited as teaching that cyanoacrylate adhesives cure rapidly in the presence of water. Admittedly, this is an inherent characteristic of cyanoacrylate adhesives. However, conventional prior art die attach processes teach heating of the leadframe, which tends to evaporate the ambient humidity. In contrast, the present method is performed at low temperatures, such that the ambient humidity stays on the lead frame. In addition, none of the cited references suggest the use of an additional catalyst, such as water or an acid, to facilitate rapid curing of cyanoacrylate or anaerobic acrylic adhesives.

The Mariotti et al. reference was cited as teaching the presently claimed cyanoacrylate adhesive formula. In addition, Mariotti et al. states at column 1, lines 33-34 that the cure speed is advantageous for production line applications. However, most everything is manufactured on a production line. Accordingly, Applicants would argue that even with this teaching, there is no suggestion of utilizing cyanoacrylate adhesives to attach semiconductor dice to leadframes. In support of this position cyanoacrylate adhesives have been known since at least the 1984 patent to Mariotti et al. However, Applicants are unaware of any prior art semiconductor production line uses of cyanoacrylate adhesives, which follow the method presently claimed, to attach semiconductor dice to leadframes.

Yet another unobvious feature of the present method is the use of fillers in cyanoacrylate and anaerobic acrylic

adhesives to tailor their characteristics to semiconductor packaging.

Conclusion

In view of the above amendments and arguments, favorable consideration and allowance of amended claims 1-22, and added claims 40-44 is requested. Should any issues remain, the Examiner is asked to contact the undersigned by telephone.

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